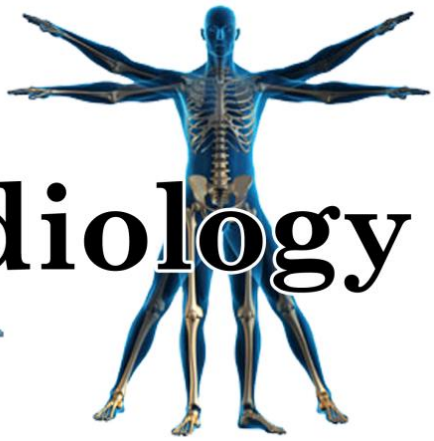


(8): Common Brain Disease1

Special thanks to Latifah Alfahad for shearing her notes

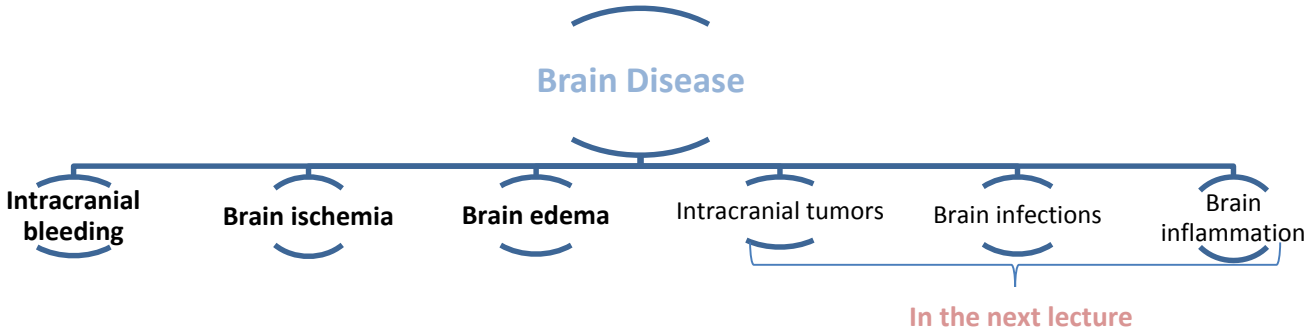
Done By:
Hessah Binjadeed

Reviewed By:
Hessah Binjadeed
Othman.T.Almutairi.

COLOR GUIDE: • Females' Notes • Males' Notes • Important • Additional

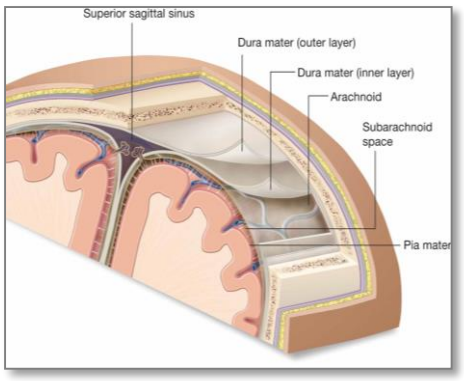
Objectives

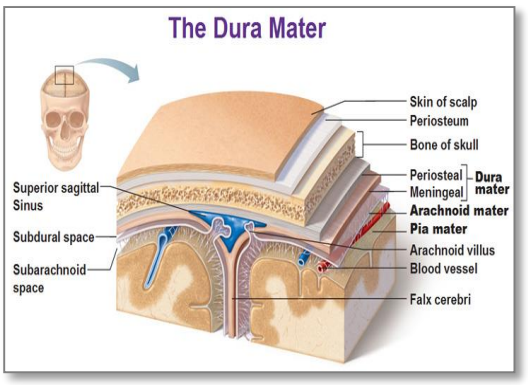
Not given



Note: The Radiological images that aren't included in this work were skipped by the doctor.

Introduction:





Note(s):

CT: bone is white.
MRI: bone is black

CT:
**hyperdense–white-(calcification-bone-blood)*
**Gray: soft tissue-Muscles*
**Black: fluid*
**very black: gas*

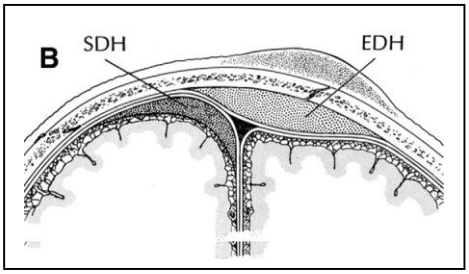
1)The inner Dura matter (meningeal) is attached firmly to the outer one (periosteal) there is no space in between, so consider them one layer. The outer layer follows the bone and the inner layer
reflects in the interhemispheric fissure or to the occipital lobe and cerebellum to make the dural reflections (falx cerebri & falx cerebelli),
So anything or any disease that is beneath the Dura should be called **subdural**, anything between the dura and the bone is called **epidural.**

2)Then after the Dura is the white layer called the arachnoid then the **subarachnoid space** (which contains the CSF)
CSF will fill these clefts (gyri and sulci) so any subarachnoid process will fill the sulci .

3)Then the layer directly above the brain is the Pia matter. (you can't strip it from the brain)so nothing is beneath the Pia matter , anything beneath it is **intracerebral**

Intracranial Bleeding:

1)Extradural (epidural).
3)Subarachnoid.
4)Intraventricular.
5)Intraparanchymal.



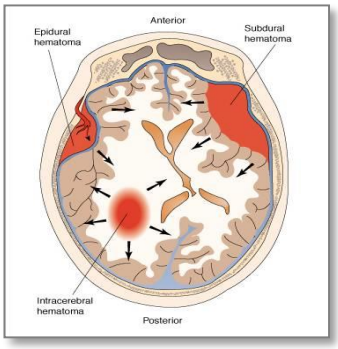
Note(s):

Blood in CT:

**Hyper-acute "within minutes": (black)*
**Acute: hyper-dens (white)*
**Sub-acute "after 2-3 days" iso-dense (gray)*
**Chronic: hypo-dense (black)*

1)**Epidural hematoma**, when it reaches the suture it would not cross because the dura will stop at the suture and the blood will be stuck between the bone and the dura. And it will cross the falx, inter-hemispheric fissure and any dural reflection because it is outside the dura anyway.

2) It's vice versa with **subdural hematoma**, when it reaches a suture it will cross it and spread because it's far from the bone. And it will follow the dural reflections and enter the falx and fissures. More dangerous because of attachment to underlying tissues



Epidural Hemorrhage:

- Blood collection between inner table and dura.
- Biconvex (lentiform).
- Occur at site of impact.
- 95% unilateral, supratentorial.
- Does not cross sutures.
- Can cross falx and tentorium, doesn't cross sutures but crosses flax because it's not deep into the dura.
- Skull fracture in 90%.
- Air seen in 20%.
- Arterial 90%, Venous 10%
- Non-traumatic-rare
- Lucid interval-50% after head impact loss of consciousness then becomes awake for sometimes then lose it again.
- C/F: headache, nausea, vomiting, convulsions, herniation. If it's large _> blurred vision, respiratory arrest. Symptoms of increase ICP
- Mechanism: Trauma, effect: artery: Middle cerebral artery

1-**Abnormal**: biconvex thing that is outside the brain but within the cranium, we know it's outside the brain because it pushes the brain aside so this **is extra-axial or extra--cerebral**, it looks like a **hematoma**.
2-It's epidural because it is confined within a limited space not entering sulci

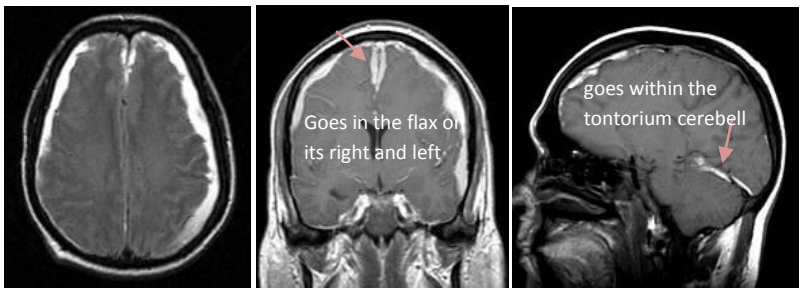
Subdural Hemorrhage:

- Blood collection between dura and arachnoid.
- Crescent shape.
- Supratentorial.
- Cross sutures, but not dural attachments.
- May extend along falx and tentorium The presentation of SDH is more symptomatic (because of its large size and herniation)
- Trauma is the most common cause.
- Acute: 6hr-3d.
- Sub-acute: 3d-3w it will become darker (greyer).
- Chronic: >3w you will see it like CSF.
- Mechanism: acceleration RTA – effect: veins

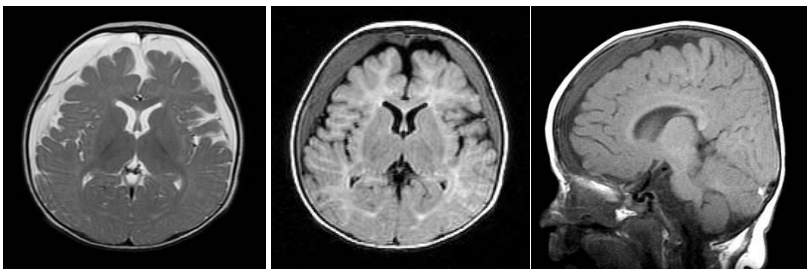
Active bleeding "hyper-acute"

Herniation-brain midline is shifted to the right-brain tissue is herniating to the other side >there is something inside the cranium but outside the brain (mass effect). it differs from the first case because the shape is different and it's large in size **(no sutures)** and there are black spots inside it indicating active bleeding, so when blood is clotted it becomes white on CT, the shape is convex from outside and concave inside so it's lunar.

This is **MRI** because **bone is black**, and over it is the skin, which is white, here there is subdural hematoma, which is outside the brain and enters the dural reflections



T2WI (MRI), the fluid is bright and hematoma is bright, so to differentiate we do CT scan, on CT fluid is dark and hematoma is grey, if hematoma is **grey** it means it's subacute or chronic. Here it is bilateral subdural hematoma.

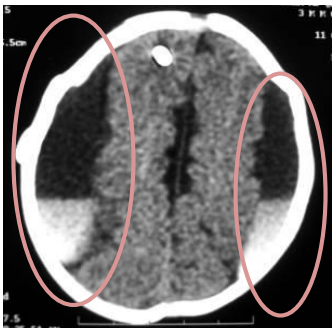


Epidural – because it crosses the falx and it is convex

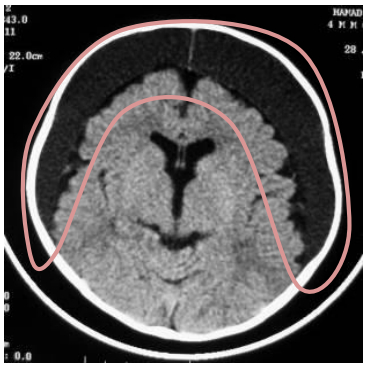
Subdural because it goes inside the falx

Subdural - Epidural

This **subdural hematoma** and not sub arachnoid, because the dark area is the subarachnoid space (which has CSF)



Baby with cerebral palsy who has **bilateral subdural hematoma** but has **active bleeding (black)=acute** and the **blood has precipitated (white)=chronic** in the dependent part of the cavity.there is ventricilo-peritonial shunt due to cerebral palsy



Bilateral subdural, with mass effect or chronic atrophy

Subarachnoid Hematoma:

- Blood between pia and arachnoid
- Traumatic (most common) 2nd most common cause: HTN then aneurysm and malformation.
- Non-traumatic
- C/F: headache, vomiting, blurred vision, neck rigidity (because of chemical irritation (not bacterial) of the blood)
- Complications: hydrocephalus (acute/delayed) (blood clots may occlude Foramen Monro ,Foramen of Magendie or Luschka or cerebral aqueduct and cause acute hydrocephalus or occlude the arachnoid villi which reabsorb the CSF and cause chronic hydrocephalus), vasospasm, re-bleeding. vessels will penetrate the dura and will run in the subarachnoid space to penetrate the brain, so if blood touches the adventitia it will irritate it and cause spasm

Note(s):

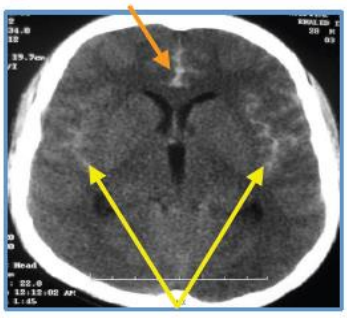
When young patient come complaining of **worst headache in his life think about aneuryism*

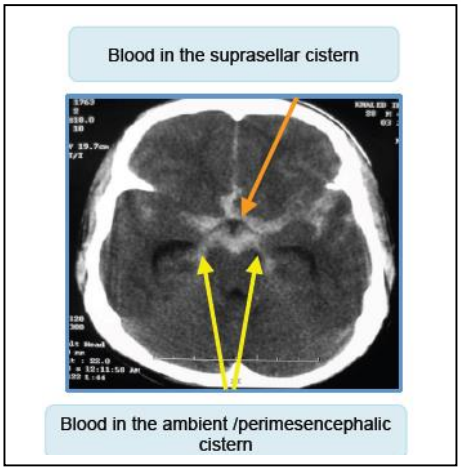
***what might cause aneurism rupture**? Steroid*

**Most common site for aneurism ACA*

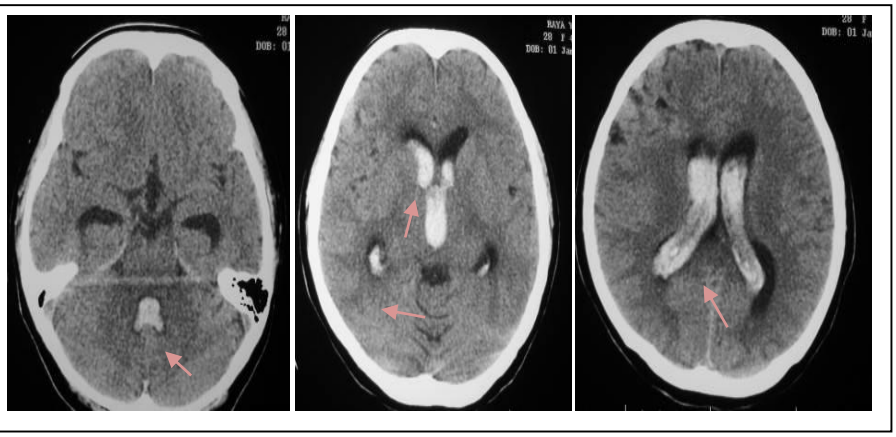
***How does SAH looks?**
Hyper density will appear inside sulci ,fissure and Subarachnoid space (inter pedinecular fossa)

All of them are filled with white material, which **is acute blood**. This is **subarachnoid hematoma** (because it is the place of CSF)





Blood in the 4th ventricle, 3rd ventricle, and lateral ventricles, so this is **subarachnoid hemorrhage**



Blood in the ventricles and the parenchyma, so **Subarachnoid and intraparyncemal hemorrhage**

Parenchymal bleed:

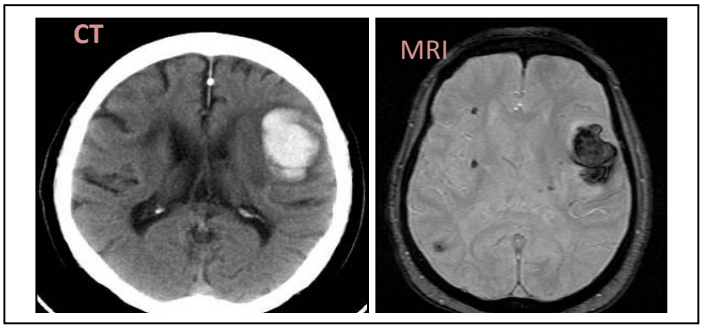
- Causes: HTN, trauma, AVM (Arterio-venous malformations) they rupture in parenchyma , aneurysm (rarely rupture in parenchyma) , prematurity, tumors (can present as hematoma, so after follow up when the hematoma disappears the tumor will be revealed) , infarction, coagulopathy

Note(s):

**Intracranial hemorrhage: the most common site > basal ganglia (sensory defect)*

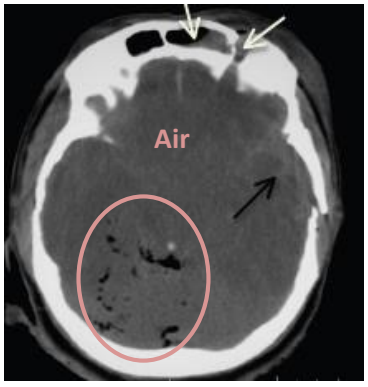
**Intra parenchyma > couagulopathy or anticoagulant*

CT blood in the parenchyma only an when you do MRI we see black spots, which are micro-bleeds and are asymptomatic and can't be seen by CT scan



Trauma:

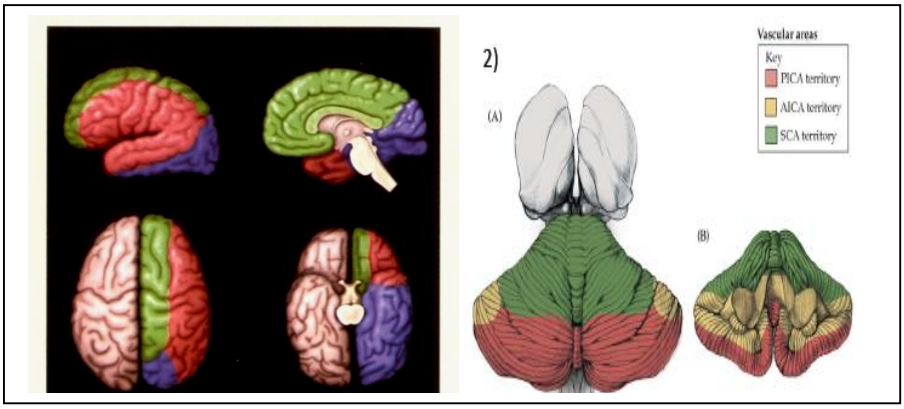
*Subarachnoid bleeding in the sylvian fissure (lateral sulcus) -> black arrow.
*There are two skull fractures
*Black areas of air (pneumo--cranium)=pneumo--cephalous , air enters the cranial cavity by fracture with skin laceration or a fracture in the paranasal sinus (in the base of the skull) or air cavity, so here if there is no skin laceration ,the fracture in the frontal sinus explains the pneumo--cranium.(light arrow)
* There is bleeding inside the frontal sinus. (white arrow)

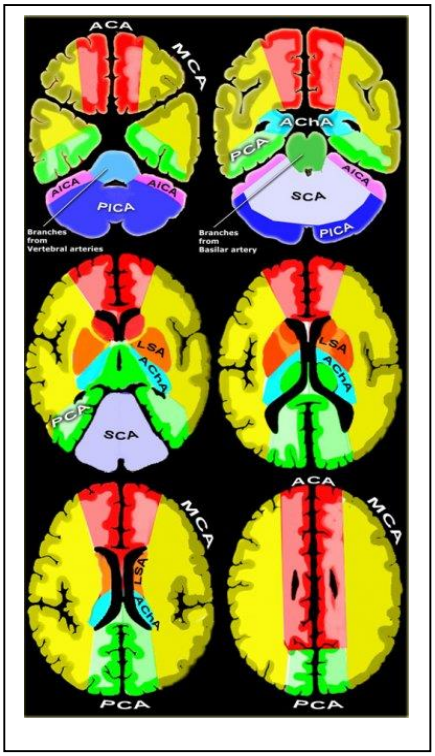


*Subarachnoid bleeding (blood in sulci, fissure and sylvian fissure)+Intraparenchymal bleeding + Pneumo--cephalous +Subdural hematoma(because there is nothing that frames the brain except SDH)+Intraventricular bleeding.
*Cases like this are usually due to road traffic accidents
*White spots that are as dense as bone: normal physiologic calcification in the choroid plexus, hemorrhage is never dense as bone

Ischemia:

*The first hours the CT will be negative for ischemic stroke, while the MRI will show ischemic lesions within minutes.
*The role of CT in ischemic stork **not to diagnose** it is to **rule out** hemorrhagic, and to rule out contraindication of ischemic stroke therapy
*How does ischemic lesion appear in CT? loss of gray and white matter differentiation.





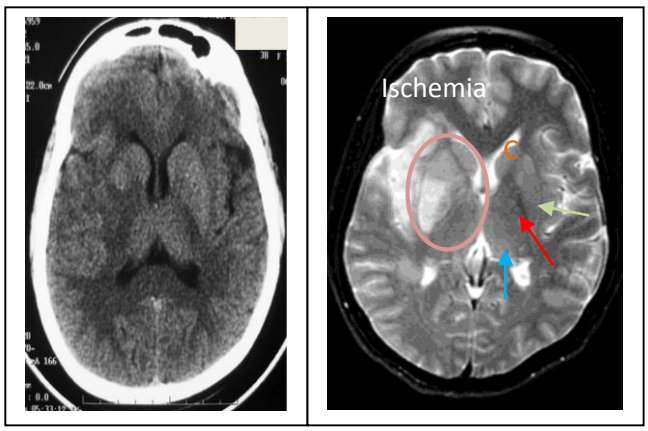
Ischemia, we need to know by heart the vascular distribution
*Pic 1)The lateral aspect of brain Is supplied by Middle Cerebral Artery
The medial aspect of brain (around the sylvian fissure) is supplied by Anterior cerebral Artery
The temporal &occipital lobes are supplied by posterior Cerebral Artery

*Pic 2)If we go to the posterior fossa, the inferior part of the cerebellum and the lateral part of the medulla are supplied by posterior inferior cerebellar artery (PICA) If we go higher up, the anterior part of the cerebellum is supplied by anterior Inferior Cerebellar Artery (AICA) Higher up the at the top of the cerebellum it is supplied by Superior Cerebellar Artery

If you see a lesion that follows vascular territory then think of Ischemia (thrombus)

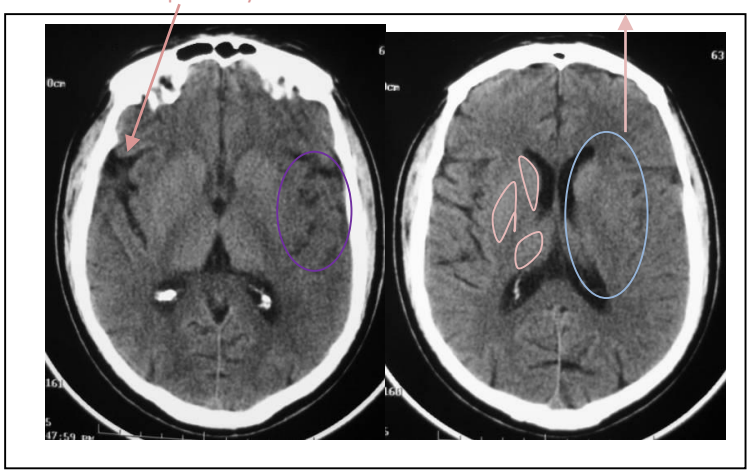
C=Caudate nucleus , P=Putamen ,G=Globus pallidus ,T=Thalamus The putamen & the Globus pallidus are abnormal on the right side, they are dark. The sylvian fissure which is normally widely open, here it is small because there is ischemia in this region, so if there is ischemia there is edema(fluid) so we lose density(lose appearance of the structure).

2-- T2WI-- MRI shows fluid in the ventricle and abnormal fluid in the area of infarction. So this area (basal ganglia) and the sylvian fissure, which is surrounded by the insular cortex, are supplied by the middle Cerebral Artery

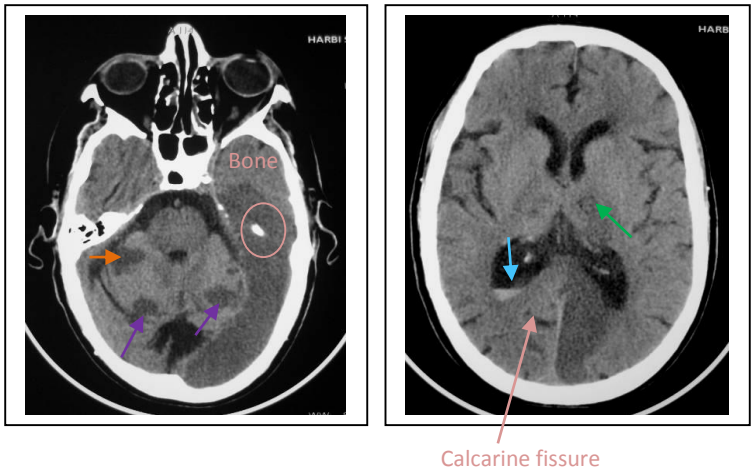


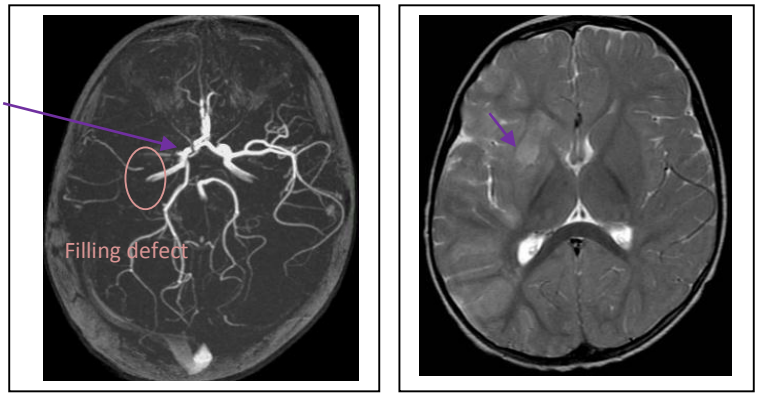
Case: this patient presented with sudden right hemiplegia, what are the findings in this CT?

The left side is hypodense (darker) in comparison to the other side, the triangle (putamen & globus pallidus) is not clear, also the sylvian fissure is closed because of the swelling of the cerebral hemisphere so CSF will be squeezed from the sulci & that's a sign of ischemia. Again in the middles cerebral artery



1--This is also PCA infarction, which is affecting the posterior part of thalamus (green arrow)
*The **calcarine fissure** is absent which indicates a swelling, and when it is **swollen** it means acute not chronic
*There is bleeding in the ventricle (blue arrow)
2--and there are other infarctions in the cerebellum by the superior cerebellar artery and inferior cerebellar artery

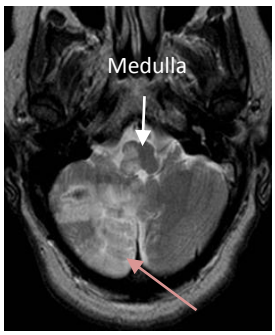




Infarction in the anterior cerebral artery, the calcarine sulcus is not seen here and the falx is pushed to the other side (edema)so this indicates that this is acute ischemia, but if it's shrunk then it's chronic. This will lead to paralysis of the right leg (monoplegia) but the hand and face will not be affected because they are represented downwards.

Acute ACA infarction

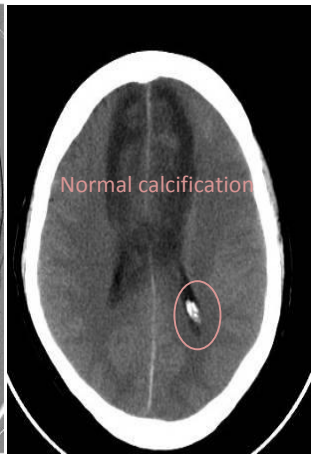
Lower part of the cerebellum is infarcted (pink arrow). We know it's lower because the medulla oblongata is seen, and those structures are supplied by the PICA



There is **bilateral Anterior Cerebral Artery ischemia** due to anterior cerebral artery aneurysm, which has bled before & thus, caused spasm then infarction

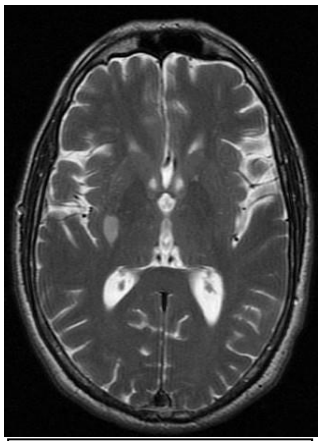
Anterior communicating artery aneurysm

Internal carotid artery

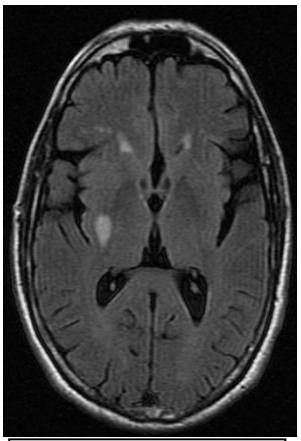


Bilateral ACA infarction as complication

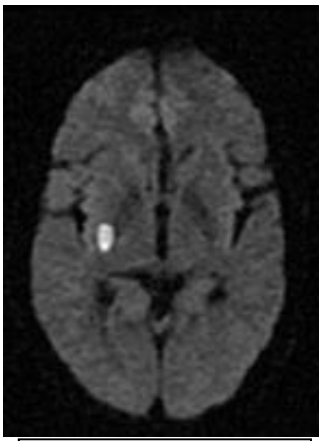
T2WI= fluid is white
FLAIR= fluid is dark (like air)
DWI= diffusion weighted image à◊ shows you a white bulb which is the infarction, this is the area of fluid restriction or diffusion restriction



T2WI



FLIAR



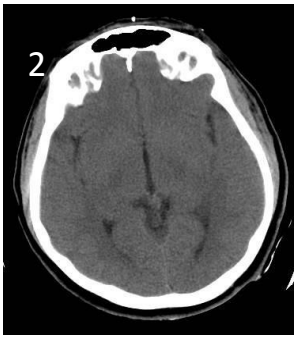
DWI

Edema:

- Vasogenic: fluid leaks from intravascular to extravascular compartment (interstitum)
  - Trauma/infection/inflammation/tumors
- Cytotoxic: fluid accumulates inside the cells and not in the interstistium, typical with ischemia.
  - Ischemia/trauma
- Both could be generalized or localized generalized vasogenic edema in meningitis or generalize inflammation. Generalized cytotoxic edema like in hypoxia, arrhythmias and drowing
- Both may co-exist
- Imaging findings:
  - Hypodensity on CT
  - Low signal on T1, high signal on T2 & FLAIR (it is fluid)
  - Loss of GM/WM interface GM/WM = gray matter/white matter
  - Compressed ventricles
  - Effaced sulci & Cisterns (Dense cerebellum because cerebellum is a posterior fossa structure along with the brain stem, and usually when there is suffocation the posterior circulation is more resistant to ischemia because it has mature compensatory mechanisms, which is the last to shut down. So the density of cerebellum is relative, because other structures are dark due to ischemia so it is an optical illusion)
  - Brain herniation (The cranial cavity will not accommodate the swollen brain so it will herniate into foramen magnum and subsequently will compress the brain stem leading to cardiac and respiratory arrest)
  - Vascular compression-ischemia

1-You **can't differentiate between grey and white matter,** you see grainy picture, no sulci, no basal cystirns, no ventricles, and cerebellum is a little bit dense
2- 3 weeks after treatment we started to see the ventricles, sylvian fissure, occipital horns so that's an improvement

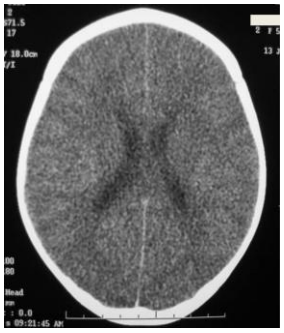
Pseudo sign = no bleeding



Diffuse loss of white gray matter differentiation

2 year old female child who nearly drowned in a swimming pool, ventricles are not compressed yet but the **differentiation between GM & WM is not that good** it is a very grainy image, sulci are not clear (effaced), no basal cisterns because the brain started to herniate, we can see a little bit **dense cerebellum or tentorium**. These 2 cases were generalized.

Pseudo subarachnoid sign = no bleeding

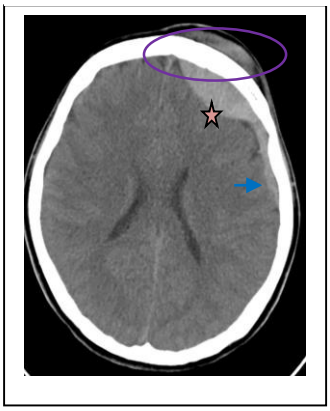


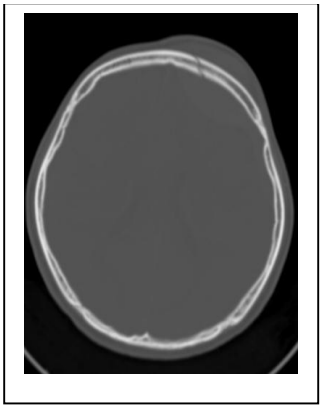
	Vasogenic	Cytotoxic
Location	White matter (it's part of the interstitium)	Gray matter (in the cell)
DWI	Non-restricted	Restricted (appear like white bulb)
Shape	Finger-like (fibers)	Diffuse (like basal ganglia or gray)

Quiz:

1. The cause of this hematoma is:

A. Anticoagulation B.Hypertension C.Ruptured aneurysm D.Trauma



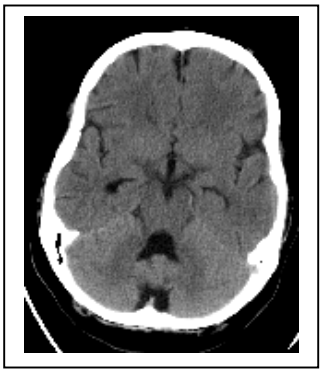


Dx: Epidural & Subdural Hematoma

-Subdural because it crosses the coronal suture (blue arrow)
-Trauma can cause both together, there is a sign of trauma, which is scalp swelling.
-The epidural hematoma is typically located at the site of trauma (pink star)
-There is a fracture

2.

Normal

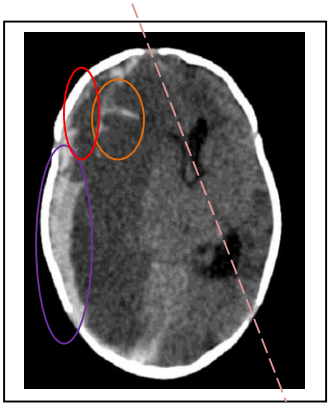


Dx: **Subarachnoid hemorrhage** because the cisterns and the brain stem and the sylvian and interhemipheric fissures are filled with blood.

There could also be edema

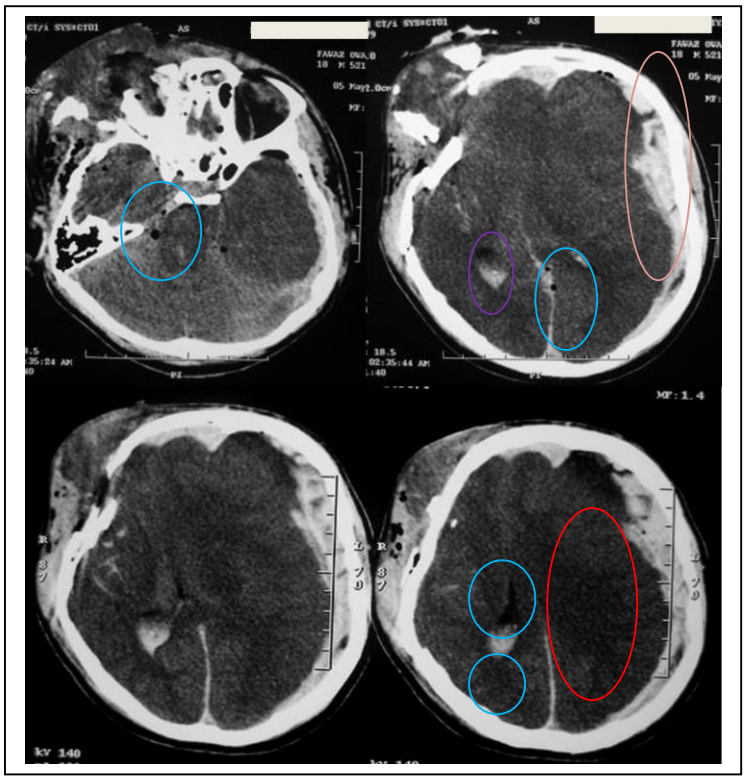
3. This CT shows:

A. Subdural hematoma B.Subarachnoid hemorrhage C.MCA infarction D.All of the above



This is a case of midline shift and herniation in a child with large ischemia in the right hemisphere, with subarachnoid bleeding and large subdural hematoma crossing the coronal suture with a black area indicating active bleeding

4.

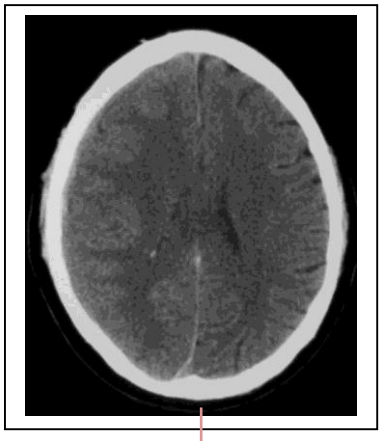


Severe trauma to the face and head, there is intraventricular bleeding, air, subarachnoid bleeding in the sylvian fissure and subdural bleeding

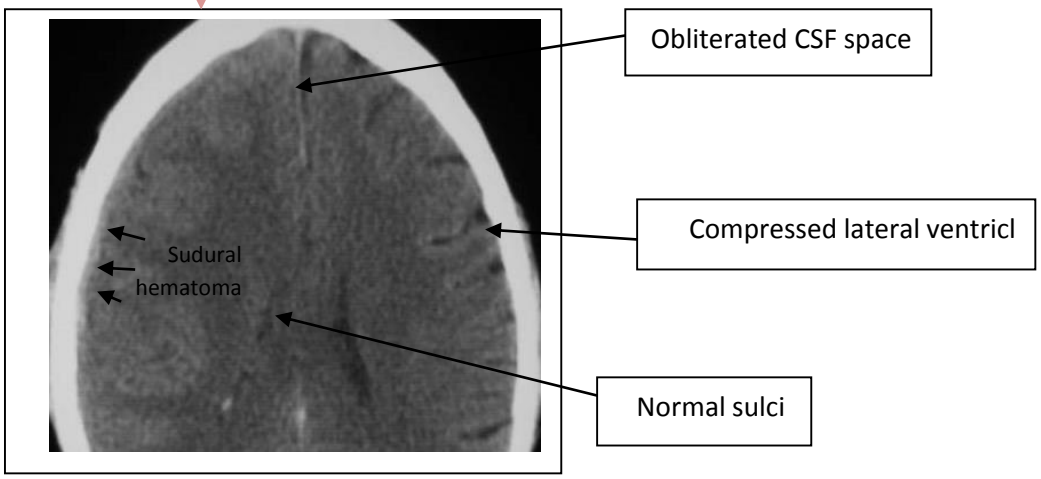
1. SDH
2. IVH
3. SAH
4. Pneumocephalus
5. Edema

5. This CT shows:

A. Epidural hematoma B.Subdural hematoma C.MCA infarction D. Normal brain



There is abnormality in the right side, no sulci but **we can differentiate between GM & WM so it is not edema**, in fact there is something compressing the sulci outside the brain **(very small subdural hematoma)** it's not a big issue if you miss something like this because it is usually asymptomatic but keep an eye on it because it may grow with time



SUMMARY

1. Epidural hematoma **doesn't** cross sutures.
2. Subdural hematoma **goes with the Dural reflections**.
3. Subarachnoid hematoma **fills** the normal places of **CSF.**
4. We can use T2WI,FLAIR and DWI in brain ischemia or infarction.
5. **DWI** gives a fast diagnosis of **new infarctions.**
6. Brain gyri are swollen and sulci become smaller in **acute ischemia** due to edema while it's the opposite with chronic ischemia.
7. **Edema** compresses ventricles and fissures and results **in loss of GM/WM differentiation.**

Questions

1) Regarding epidural hemorrhage, choose the correct answer:

A. It occurs in older age group compared to subdural hemorrhage.
B. It's curvilinear in shape.
C. It occurs between the dura matter and the brain tissue.
D. It's usually caused by trauma e-- It's not limited by sutures

2) Cytotoxic edema can be caused by which of the following:

A. Gliomas
B. Cerebrovascular accident (CVA).
C. Infection.
D. Metastasis
E. Dehydration.

3) John is 20 years old, he had a car accident and came to you in the Emergency Department of KKUH. After that you did a CT scan to him, the findings were some hemorrhage that was limited by sutures. Based on this finding the pathology is most likely:

A. Epidural hematoma.
B. Subdural hematoma.
C. Subarachnoid hematoma.
D. Intra parenchymal hematoma.
E. Intra ventricular hematoma.

432 Radiology Team Leader

Eman AlBedaie

Emansaleh202@gmail.com

Answers:

1st Questions: D

2nd Questions: B

3rd Questions: A